Smart Switch

Jake Joraanstad Ben Whittier
Joe O'Donnell and Darren Stewart
Advisor: Dr. Roger Green
SD1201

The Problem

Current energy monitoring and automation systems are:

- Proprietary
- Expensive
- Purposefully keep out other hardware manufacturers
- Outdated technology
- NOT user-friendly

What is Smart Switch

Smart Switch is a proof-of-concept and prototype of a cloud-based, open, simple, and intuitive energy monitoring and automation system we would like to see in the market in the near future

Smart Switch Hardware

On/Off functionality

- Digital output pin controlled by android device toggles between 0V-3.3V
- Solid State Relay is controlled by capable of handling 120V 2A

Temperature Sensor

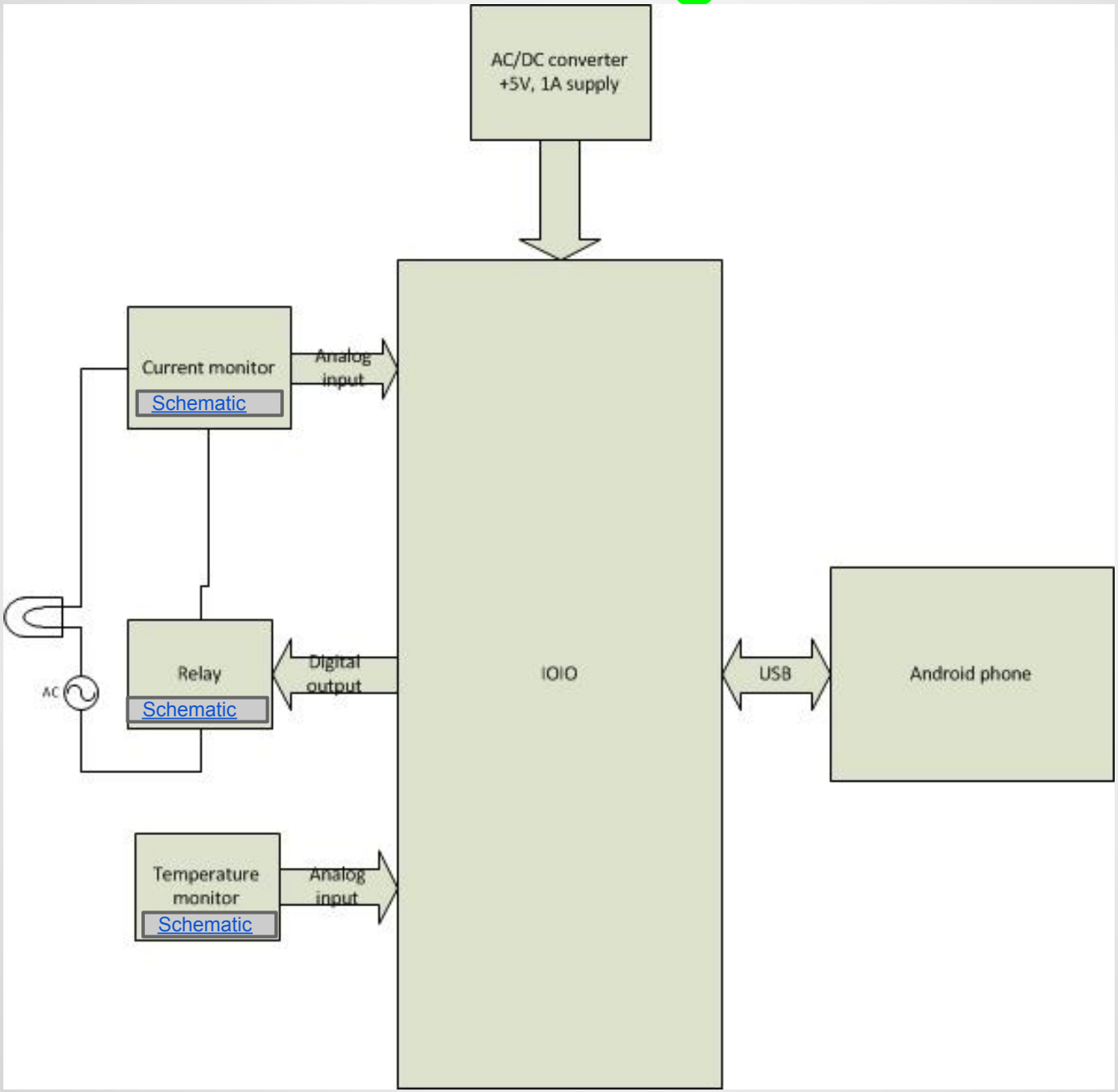
- thermistor that has a 1k resistance at 72 degrees F in series with a 1k resistor connected to a 5V source
- Analog input pin 42 measures the voltage drop across the thermistor

Smart Switch Hardware - Continued

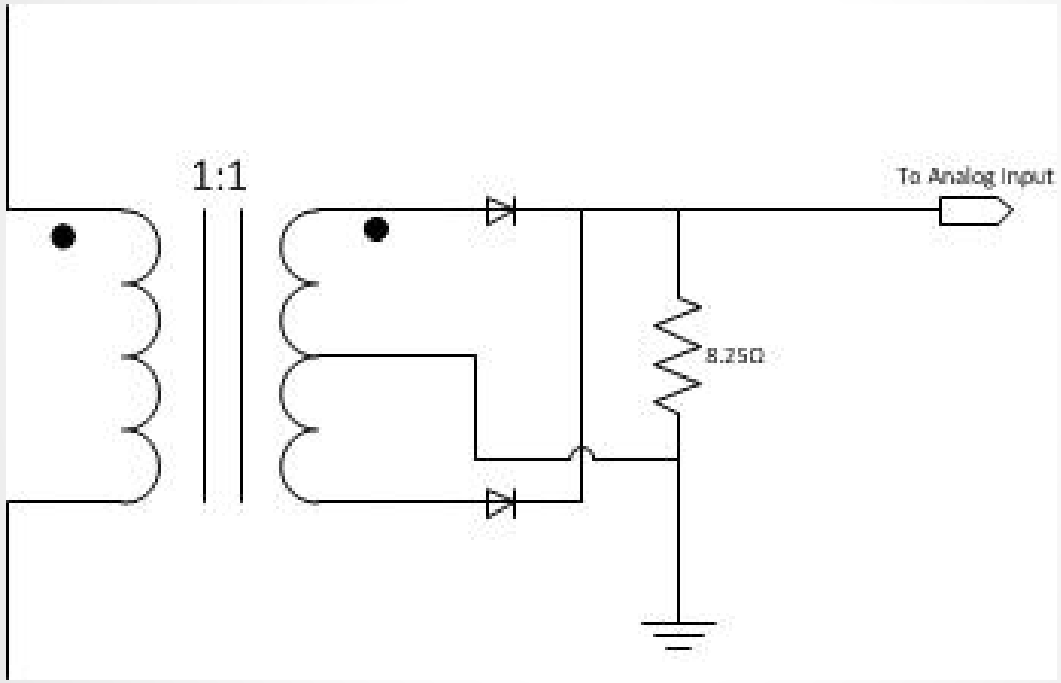
Current Monitoring

- 1:1 transformer to isolate 120V from our circuit
- Transformer sends current across an 8.2 ohm resistor

Hardware Block Diagram

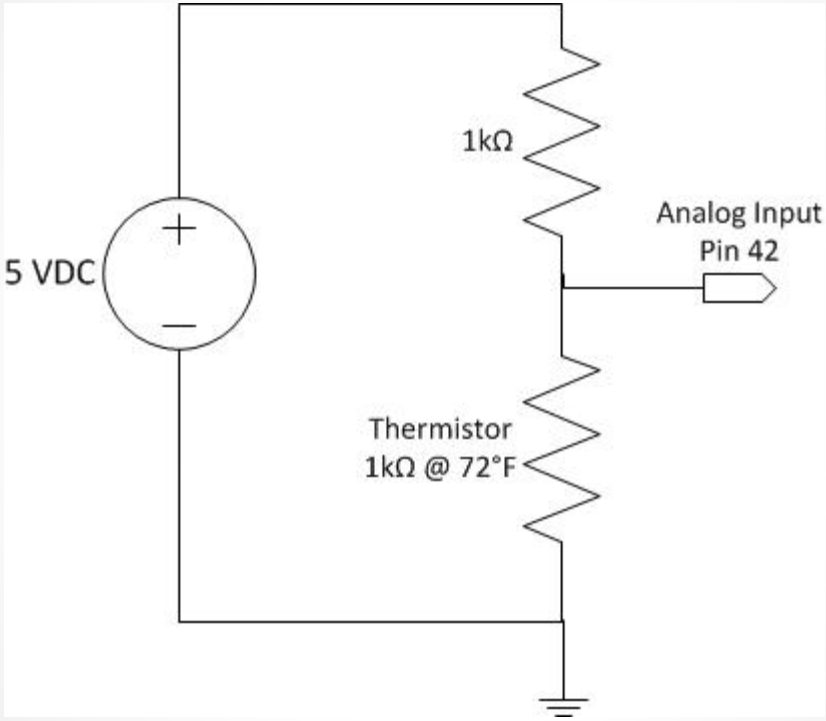


Current Monitoring Schematic



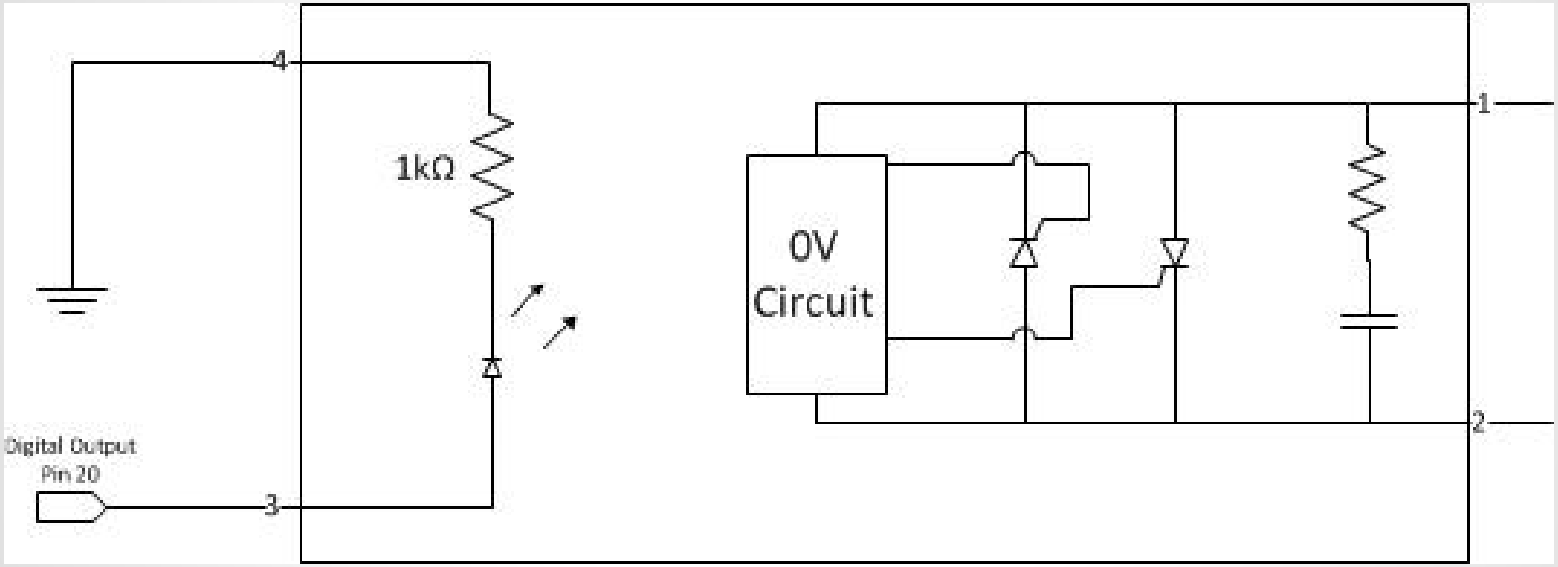
Back to Block Diagram

Temperature Monitoring Schematic



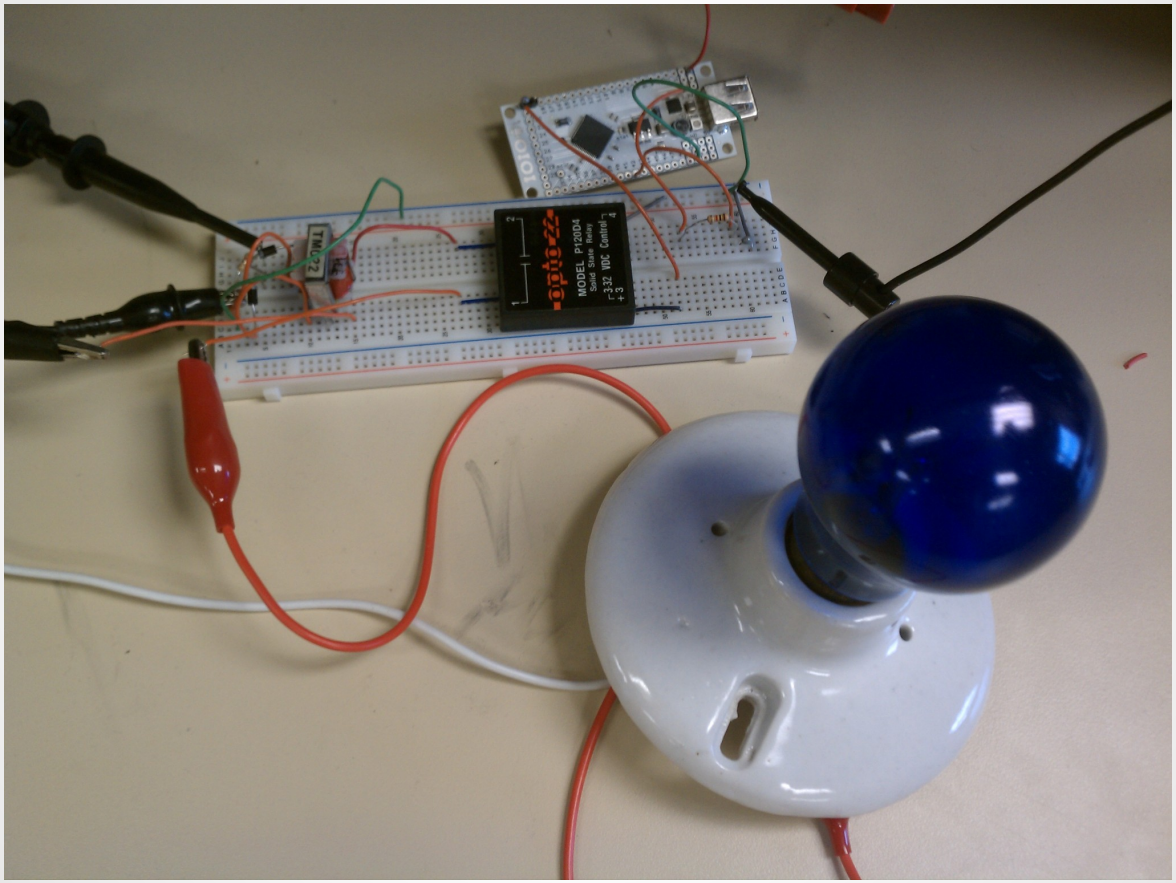
Back to Block Diagram

Relay Schematic



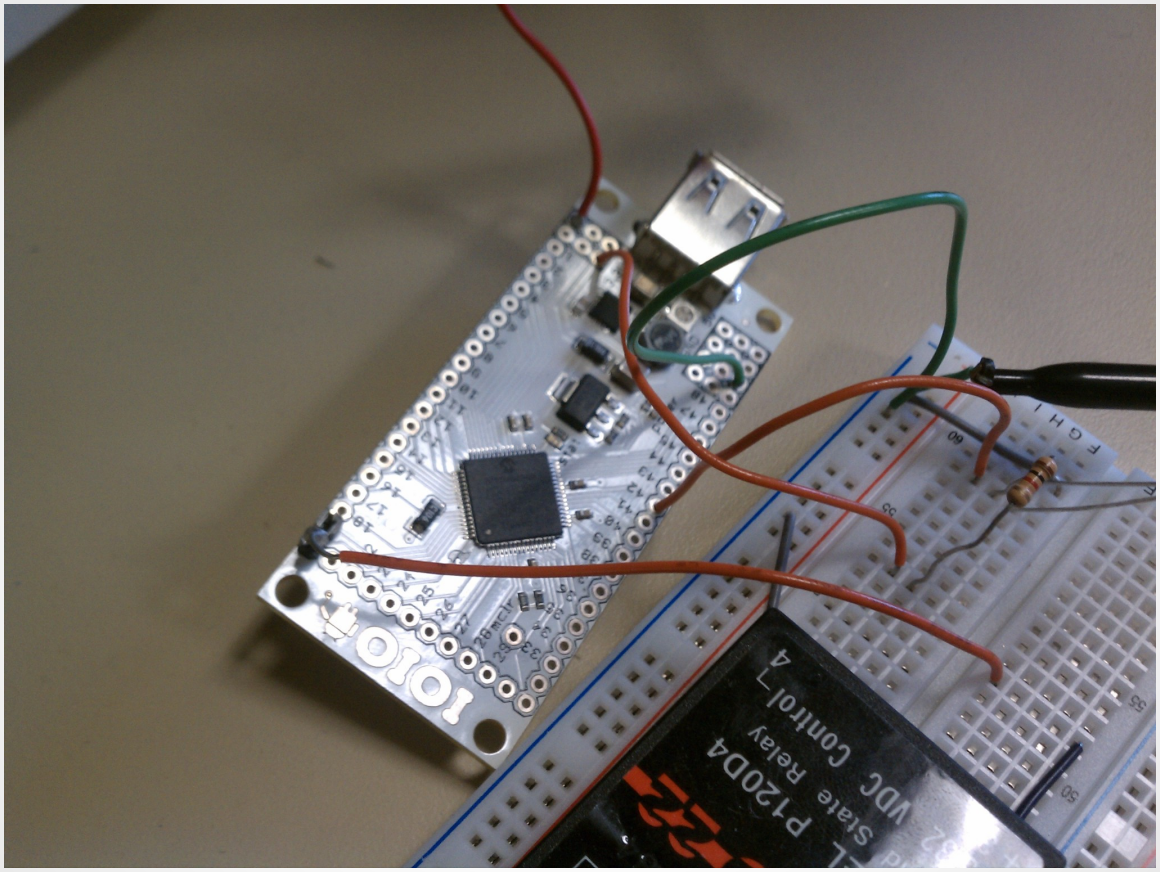
Back to Block Diagram

Pictures of Current Hardware Setup



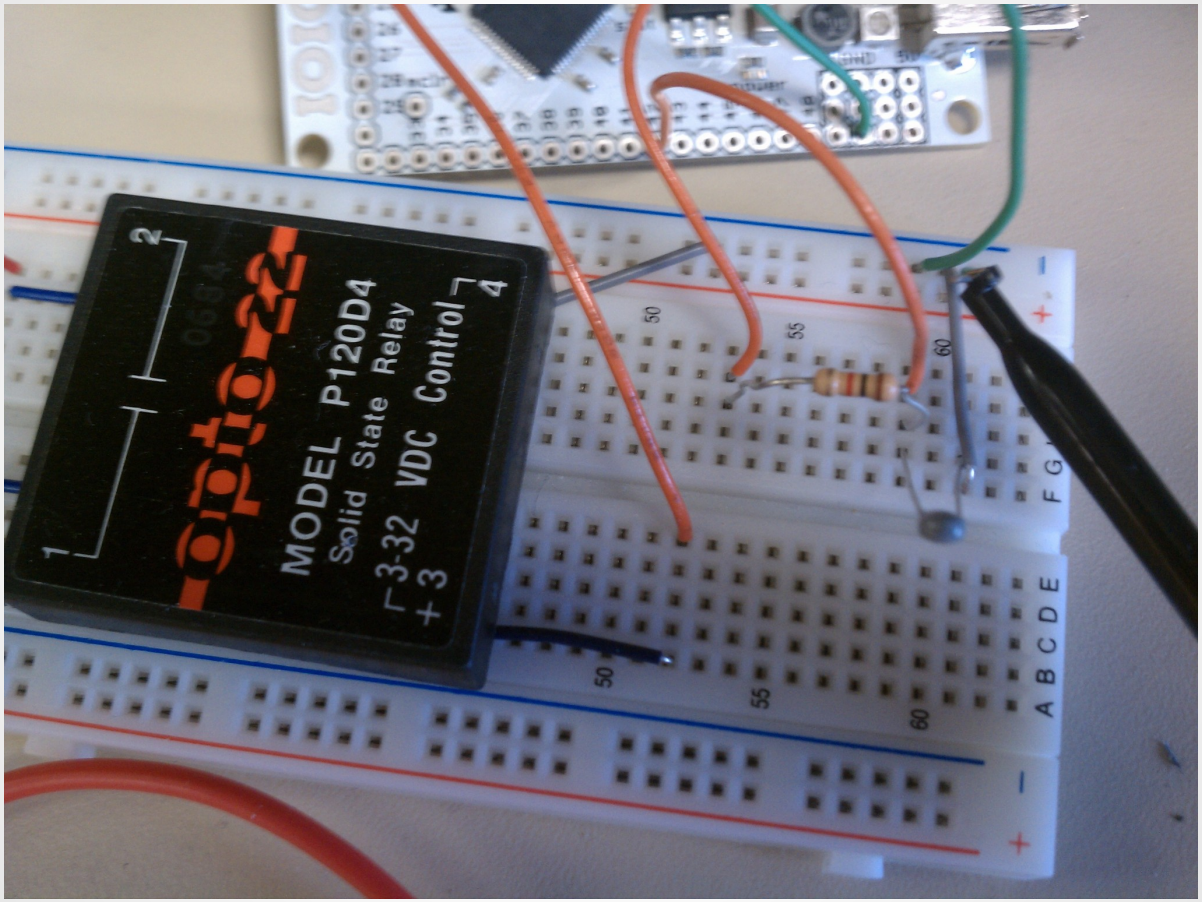
Overall Hardware Design

Pictures of Current Hardware Setup (continued)



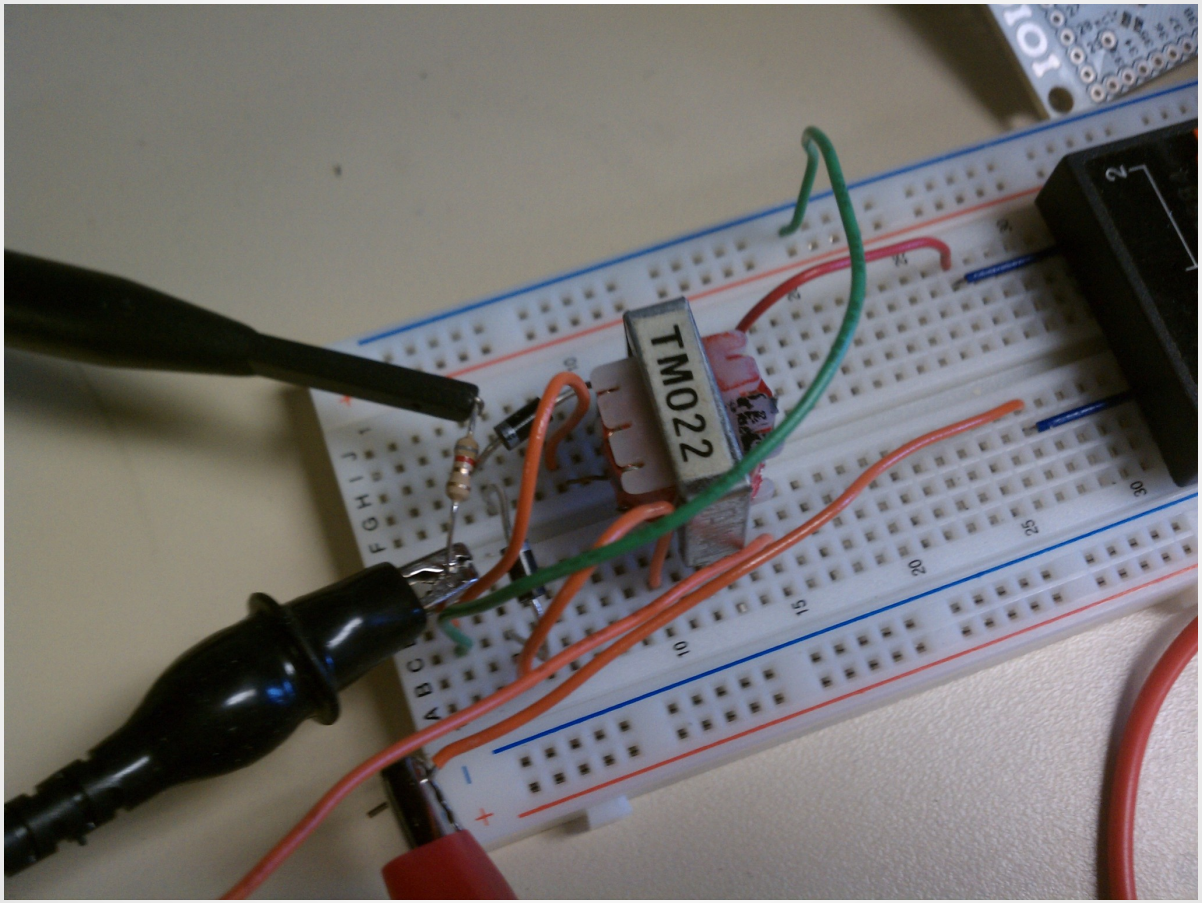
ioio Controller Board

Pictures of Current Hardware Setup (continued)



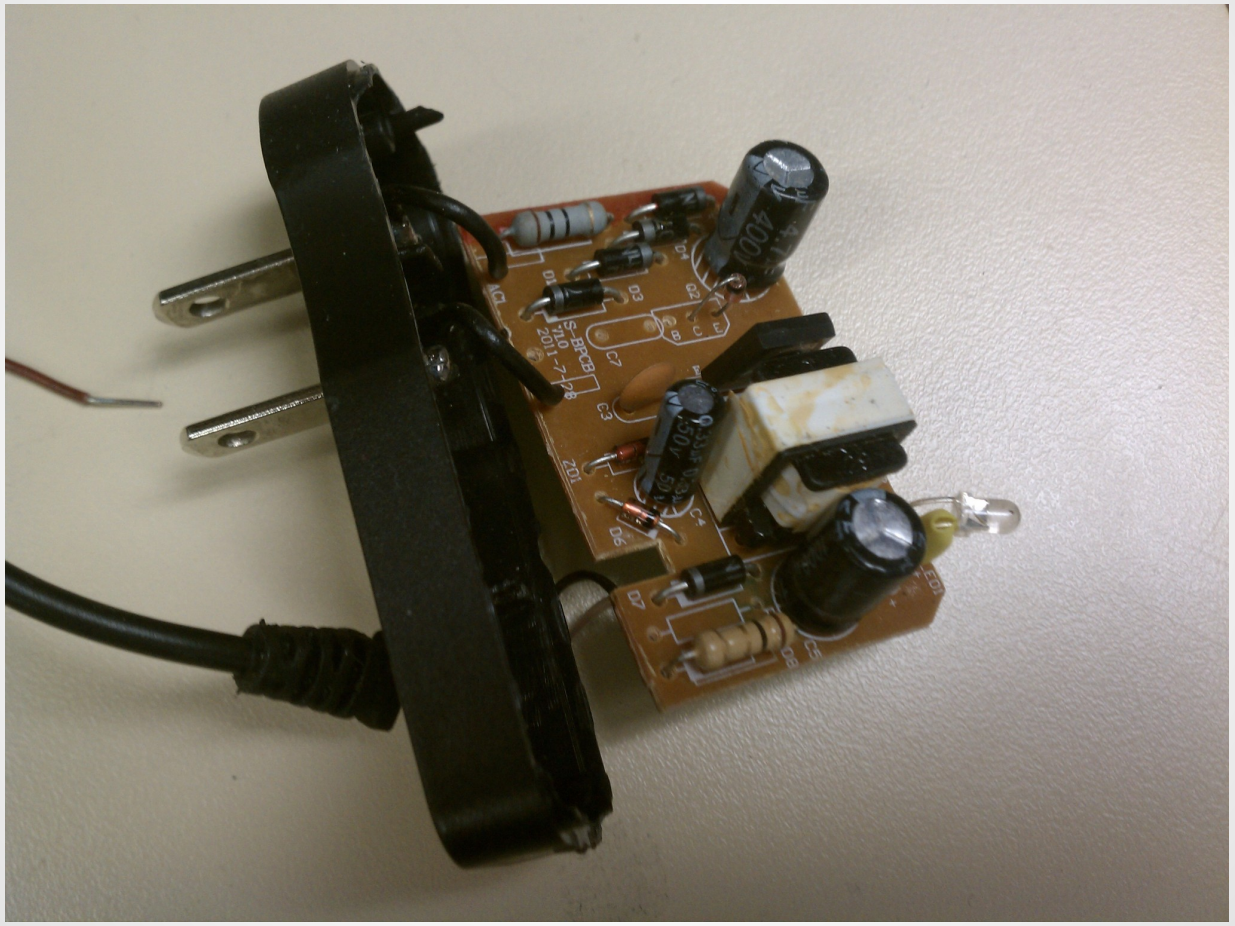
Relay + Thermister Circuit

Pictures of Current Hardware Setup (continued)



Current Monitoring Hardware and Circuit

Pictures of Current Hardware Setup (continued)



AC/DC Converter Hardware

Future Hardware

Purpose-built, efficient hardware

- Read a digital input from the current monitoring circuit to sync a PWM signal with the zero crossing of the 60Hz power
  - This will allow us to control the dimming of the light
- Purpose-built board with low-energy WiFi communication for efficient cloud-based monitoring and automation
- USB input for simple configuration of device with phone or tablet
- Small, affordable package with simple installation into existing platforms
  - power outlets and light switches

Switch Software

Power and Temperature Monitoring

- Ability to monitor on/off times as well as ambient temperature

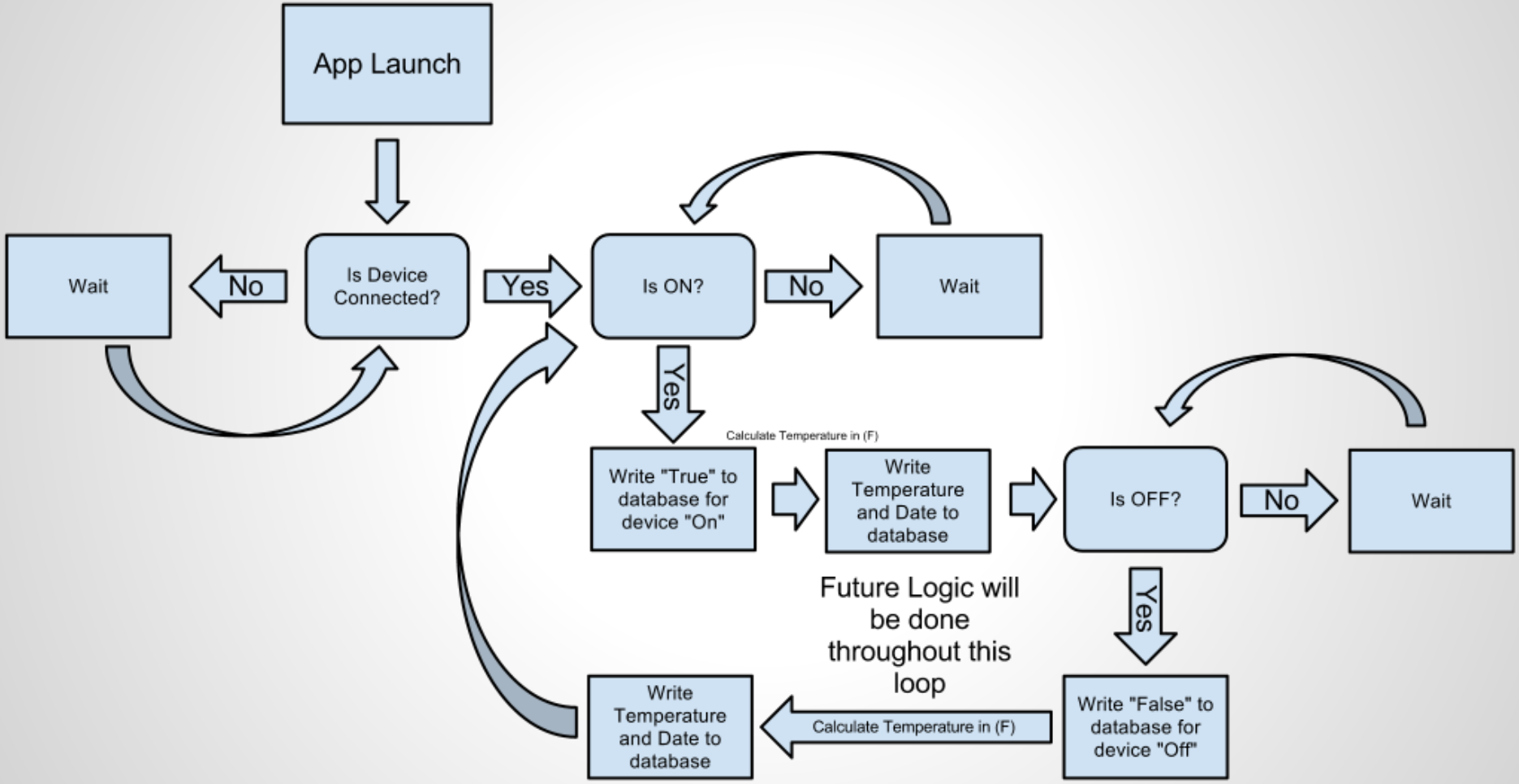
Cloud Monitoring

- Data synced to the cloud for processing in near-real time
- Web interface for viewing of data

On/Off Capabilities

- Simple on/off capabilities controlled by Android software utilizing Android Open Accessory Protocol

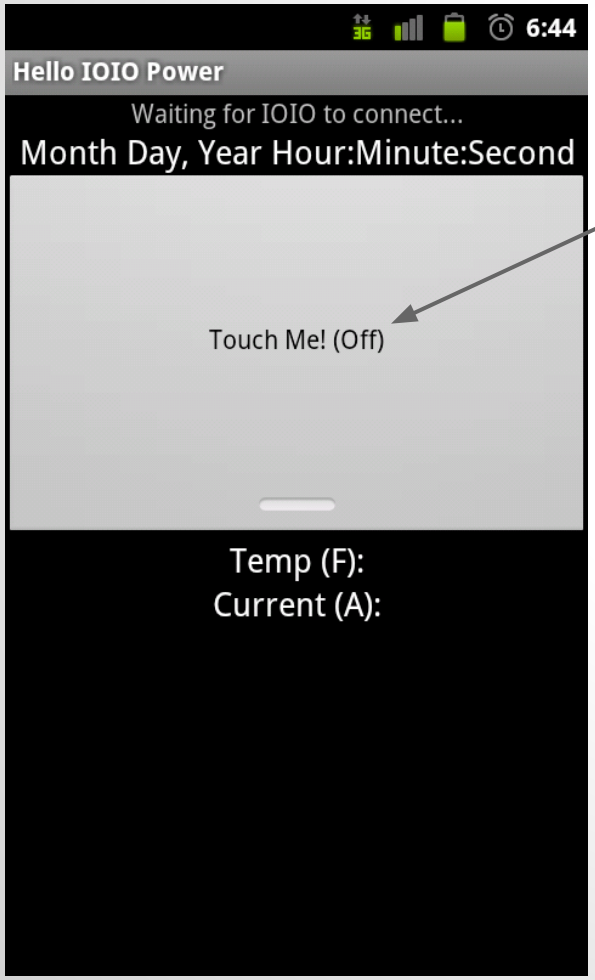
SmartSwitch Flow Chart



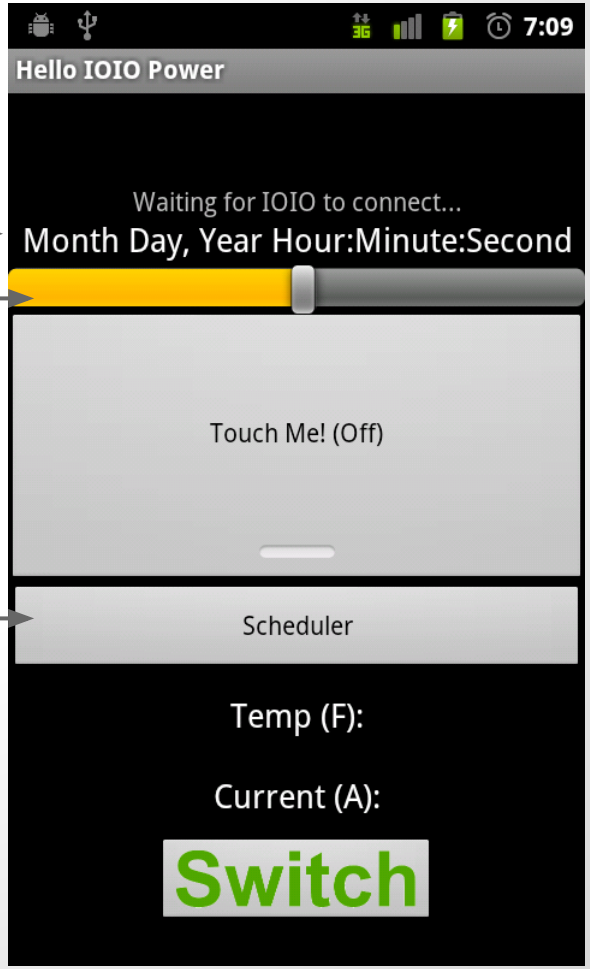
Future implementations of software and hardware will alter this design

Screenshots of Current Software

Mobile App Initial Build



Mobile App Current Build



On/Off

Date/Time

Dimmer

Scheduler

Real Time Read Out

Switch Software (Website)

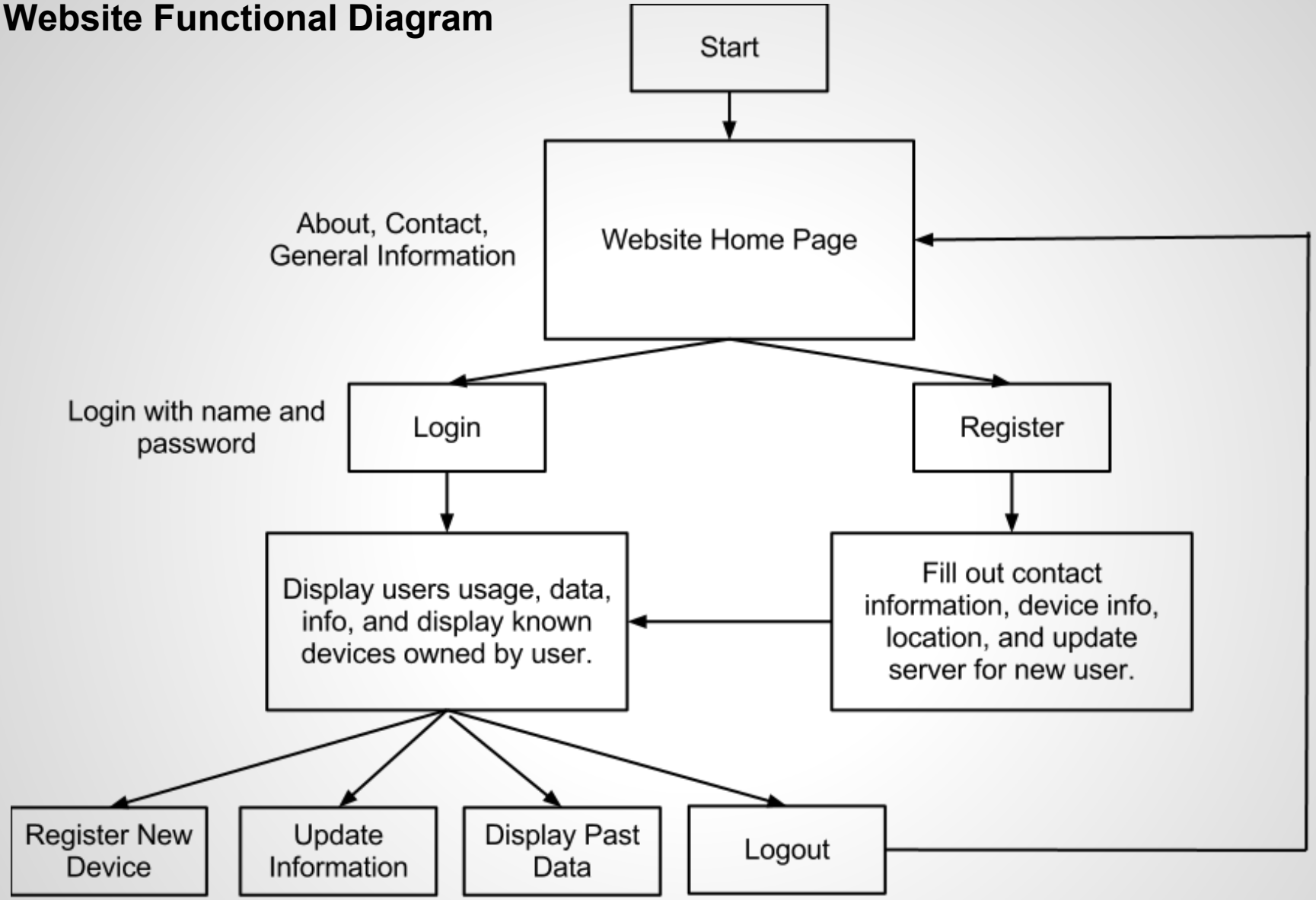
Attractive and functional Website to display data from Android Application.

- Keep track of current and past data and display in convenient forms.
- Use modern techniques to construct an impressive looking website that meets requirements.

Cloud Monitoring

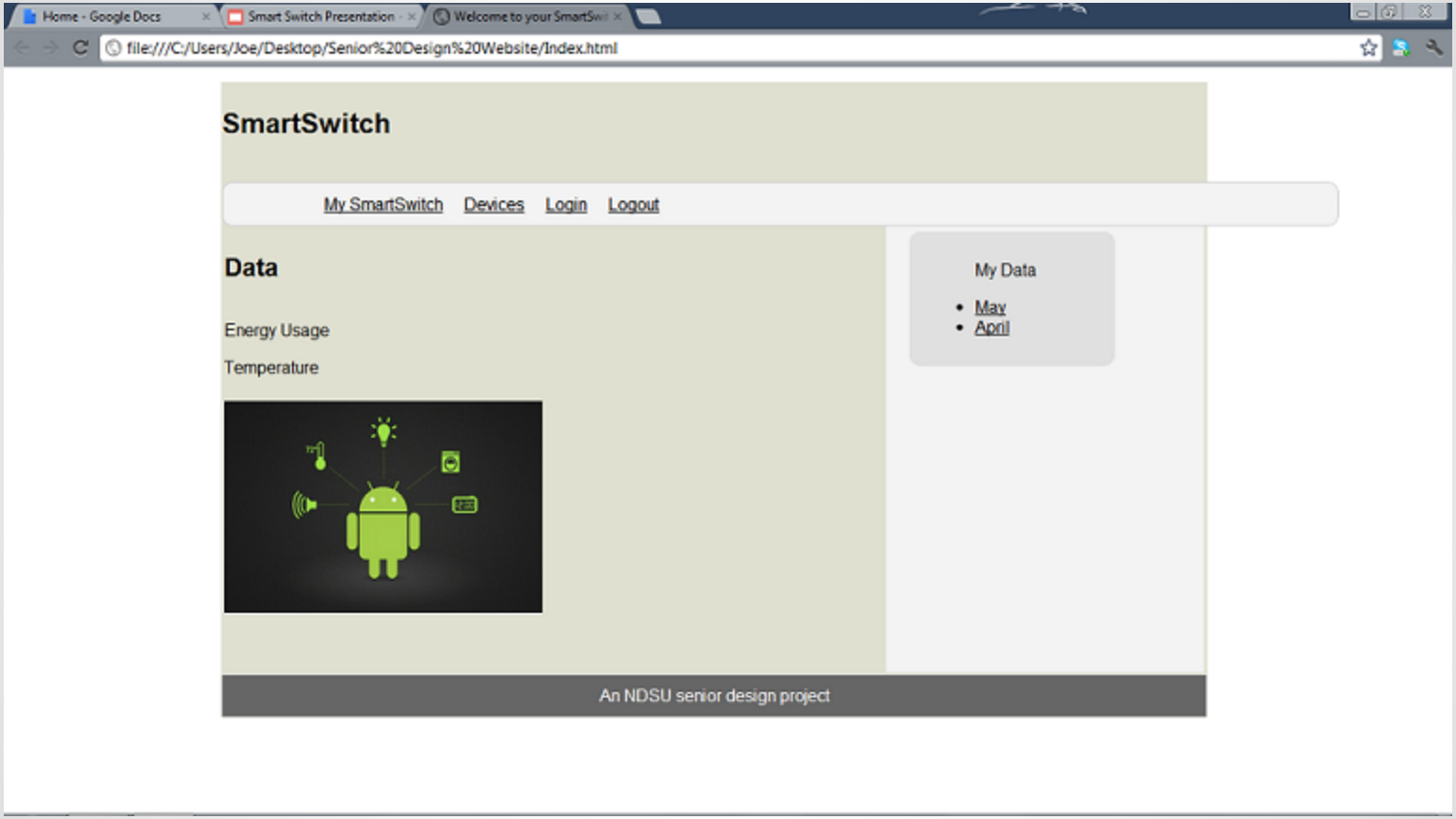
- Gather information from the device via a cloud database to display on a website accessible from anywhere with internet access.

Website Functional Diagram



Future implementations of software and hardware will alter this design

Website Preview (Under Development)



Future Software

What we'd like to see/do

- Implementation of a modern, functional website that is capable of displaying data from the device via graphs and charts.
- Development of a sleek and efficient Android phone application that works in conjunction with our developed hardware to get information to the website.
- Possible server solution to handle multiple test users and actual website functionality.

The Future of Smart Switch

- Every house and business in the America
  - Create an affordable energy monitoring and automation system
- Simple Integration and Multiple Options
  - Finally buy off-the-shelf hardware and integrate with Switch and other existing hardware
- Hardware Manufacturers
  - Partnerships and relationships

Timeline

- We are currently on track with our original timeline (see attached pdf)

Budget

Part	Qty	Unit Cost	Total Cost	Cost to our funds
Current transformer	2	3.75	7.50	7.50
AC/DC converter	1	3.00	3.00	3.00
IOIO board	1	49.95	49.95	49.95
Triac	2	1.77	3.54	3.54
1:1 Transformer	1	3.00	3.00	0.00
Diodes	2	0.01	0.02	0.00
Resistors	2	0.002	0.004	0.00
USB cable	1	3.00	3.00	3.00
Droid Incredible phone	1	50.00	50.00	50.00
Thermistor	1	0.01	0.01	0.00
Solid state relay	1	2.60	2.60	0.00
Total			**122.63**	**116.99**

Next Steps for Smart Switch

- Hardware
  - Finalize current monitoring
  - Implement dimming control
  - Design and build a PCB for all hardware to fit into an enclosure
- App
  - Current monitoring software
  - Converting to kWh
  - Cloud-based automation
  - Schedule system
- Web
  - Gather data from cloud via server
  - Save data for user access over time
  - Professional web UI
  - Create user system

Boom.

A+. Let's go home.